Overall Objective of Proposed ICEPRO Focus Group

- **Better characterize ice physical properties & processes by establishing linkage between observed ice properties (means, distributions) & models (covering variety of scales) used to investigate how cloud radiative properties change with environmental conditions**

- **ICEPRO focuses on**
  1. **Establishing how uncertainties in ice properties affect associated process rates & model results**
  2. **Quantifying uncertainties from in-situ data that serve as basis for model parameterizations of mass-based ice crystal properties**

Available Data on Ice μphysics

- Large databases exist with varying accuracies
  - Not known how properties vary by location, cloud type, formation mechanism, vertical motion, dynamics, meteorology, etc.
  - Such knowledge needed for process-oriented understanding & parameterization development
- Additional data in variety of conditions needed
  - properties of individual crystals & global populations
  - Need uncertainties associated with properties
  - Need to investigate optimal representations in models with variety of scales

Representations of ice μphysics

- **Single-particle properties:**
  - **Aspect ratios, masses, areas of ice crystals**
  - **Surface roughness and its effect on optics**
  - **Fall velocities, scattering properties**
- **Particle distributions**
  - **M-D & A-D relations used in μphysics & optics**
  - **Size distributions, $N(D)=N_0 D^{\mu} e^{-\lambda D}$**
  - **Habit distributions, Effective diameter, mass-weighted velocity, scattering properties, process rates, etc.**
- **How do uncertainties cascade to larger scales?**
- **How do properties vary by location, cloud type, vertical motion, dynamics, meteorology, etc.**

Presentations

- McFarquhar, Aspect ratios, size distributions & habit identification schemes
- Mitchell, Using ice cloud measurements to improve cloud modeling
- Schwartz, Application of a cirrus statistical model to recent cirrus particle size distribution data
- Harrington, Aspect ratio evolution in two-dimensional models
- Fridlind, Ice size distribution evolution: a perspective from bin microphysics modeling of mixed-phase clouds
- Dong, Ice cloud microphysical properties retrieved from surface and aircraft during MC3E

Other Notes/Directions

- Long-term measurement campaign to collect ice crystal properties across multiple sites; need to examine how depends on altitude also; SPARTICUS on Steroids is needed
- Constrain lidar-radar retrievals with in-situ observations to increase sample size
- Measurement of crystal sizes and morphology to go with retrievals and better observations of air motion in midst of snowfall
- Holographic techniques for investigating impact of particle shattering
- Modeling needs particle fall velocity and dependence on particle size, especially in anvil region

Other Notes/Directions

- Catch crystals as they fall and melt to measure ice crystal sizes and masses
- Need ice crystal measurements in deep convection (ordinary, not necessarily hail), including in data gap region between +5 and -35C
- Figuring out when you can trust past data sets because of shattering issues
- Ice crystal initiation